GLOBAL DRIVERS OF FOREST CERTIFICATION

by

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May 2014

Masters project submitted in partial fulfillment of the
requirements for the Master for Environmental Management degree in
the Nicholas School of the Environment of
Duke University

2014

Abstract

Due to the continued high rates of deforestation and forest degradation as well as increased pressures on habitats and forest-dependent people from climate change and population growth, there is a dire need for the implementation of effective conservation mechanisms. Numerous forest certification schemes have been created in response to deforestation, stemming particularly over concern for the deforestation and degradation of tropical forests. The Forest Stewardship Council (FSC) is one such standard of voluntary sustainable forest management program that has gained global recognition. This study uses a multivariate regression approach to examine the underlying drivers of FSC forest certification: why has it accelerated in some countries and not others. I find that governance performance, community pressure, market demand, income, and habitat type were correlated with presence of FSC programs. The results of this study can be used to inform efforts to increase the reach of FSC forest certification, in turn spreading the responsible management of forests and the concomitant socio-economic benefits.

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Introduction

Background

Forests are a vital global resource, benefitting not only local communities that depend upon them for their daily livelihoods but also benefitting society at large. Globally, 1.6 billion people rely upon local forests as a means to provide food, clothing, and shelter (UNEP, 2009). On a broader scale, all societies around the world depend on forests due to forest's fundamental and vital role in the provision of ecosystem services. Some of these services include the filtration of water, regulation of floods and drought, cleansing of the air, provision of nutrients to the soil, prevention of erosion, ability to act as a carbon sink, and contribution to biological diversity (Millennium Ecosystem Assessment, 2005).

Despite these valuable benefits, forests continue to be destroyed and degraded at an alarming rate around the world (see Figure 1). Close to 30 percent of the world's forest cover has been completely deforested, while another 20 percent has suffered degradation (World Resources Institute, 2014). Along with this degradation of the environment comes soil erosion, climatic fluxes (such as increased temperature and severity of floods and droughts), reduced biodiversity, diminished water quality, and increased atmospheric carbon concentrations (Pattanayak and Kramer, 2001; Cramer, 2004; Pattanayak and Wendland, 2007; Ferraro et al., 2012; Castillo and Gurney, 2013).

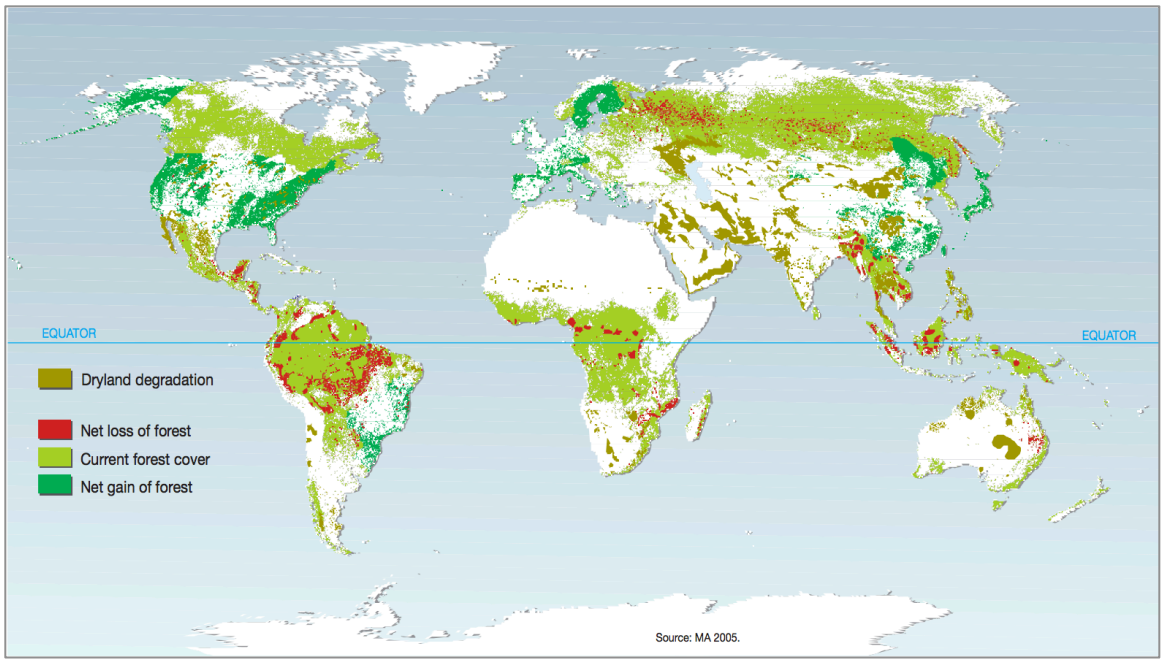

Figure 1. Changes in forest cover on a global scale. Figure extracted from UNEP (2009).

Various policy instruments exist to promote conservation particularly in tropical developing countries, as the number of threatened habitats and species are greatest in these areas (Myers et al., 2000; Hoffman et al., 2010). Among the most popular are protected areas, payments for ecosystem services, and decentralized or community-based management (Pattanayak and Wendland, 2007; Miteva et al., 2012). Specifically, this study focuses on sustainable forest management certification. This is another conservation tool that is often overlooked, particularly in regard to rigorous, empirical studies on the effectiveness of this instrument (Miteva et al., 2012).

With a growing global population, the demand for forest products is unlikely to slow. Rather, it is expected to triple by 2050 (WWF, 2012). Because society continues to depend on forest products, rather than attempting to halt deforestation, policy makers could focus on promoting responsible management of forests. Forest management certification organizations encourage voluntary environmentally sustainable and socially responsible forest management practices that allow for the continued provision of forest products (Romero et al., 2013; Miteva et al., 2014).

Since the 1990s, various forest management standards have been developed, including the Canadian Standards Association, the Sustainable Forestry Initiative, Pan-European Forest Certification, the Programme for the Endorsement of Forestry Certification (PEFC), Brazil's Certificacao Florestal, the Malaysia Timber Certification Council, Chilean Forest Certification System, and Lembaga Ekolabel Indonesia (UNEP, 2009). In line with the creation of these certification programs, there has been a growing demand for forest products that abide by environmental and social best practices. For example, the Forest Stewardship Council (FSC) has one such standard of forest management that has gained global recognition and successfully infiltrated the timber market through participation across the supply chain, from forest manager to the consumer. Unfortunately, the two most prevalent forest certification schemes - PEFC and FSC - cover just over ten percent of the world's forests (see Figure 2). While PEFC is the leader in terms of amount of certified forest area, FSC follows close behind and has been found to be the most rigorous and comprehensive due to its focus on political, environmental, social, and economic sustainability (Romero et al., 2013).

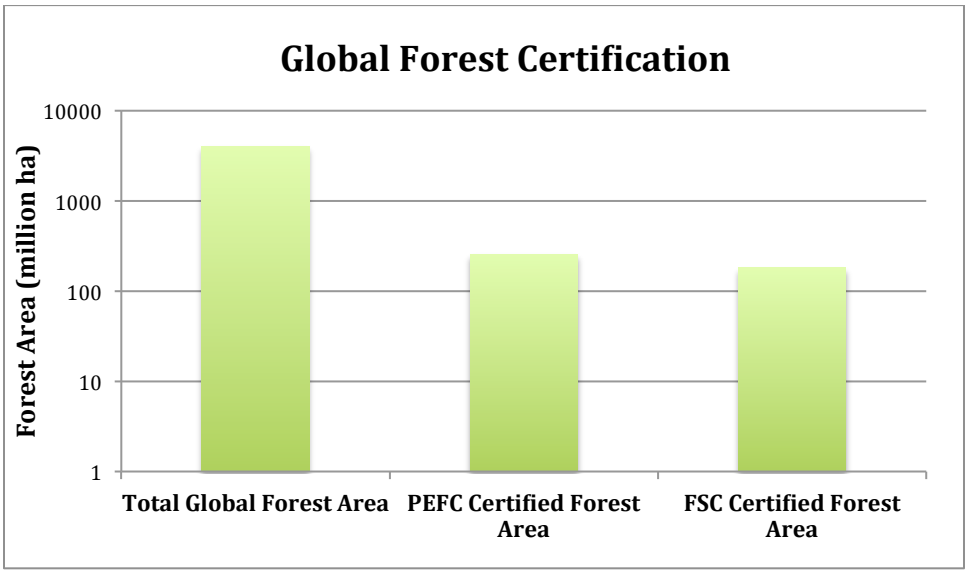

Figure 2. A look at the two most extensive forest certification schemes in relation to the world's total forest area. Of the world's forests, 4.5% is under FSC certification and 6.4% is under PEFC certification. Note, the y-axis of this graph is on a log scale.

Forest certification is now widely supported as an effective means of both forest and species conservation (Zagt et al., 2010). As managed forest concessions, these certified areas fall somewhere between intact natural habitats and traditionally logged plots in terms of species richness and diversity (Putz et al., 2012). Previous literature supports these results about the effectiveness of FSC forest certification, finding positive outcomes in regards to species richness and diversity (Cannon et al., 1998; Edwards et al., 2009, 2011), forest loss and degradation (Medijibe et al., 2013), and local community health and development (Romero et al., 2013). Unfortunately, none of these have employed rigorous causal impact evaluation methods (Pattanayak, 2009) to determine if FSC has indeed improved forest, environmental and socio-economic outcomes. Miteva et al. (2014) is a rare exception in finding causal evidence of reduced deforestation and other environmental and socio-economic benefits to local populations.

The Forest Stewardship Council

The idea of a forest certification from the FSC first emerged in 1990, when industry along with environmental and human rights organizations came together over unified concerns of increasing deforestation, degradation, and social exclusion particularly in the tropics with hopes to create a global forest certification system (FSC, 2014a). Three years later, the first FSC certificate for forest management was issued in Mexico. Since that time, FSC has received continued support and participation (see Figure 3). As of January 2014, a total of 1,265 FSC-certified forest management certificates were active in over 80 countries, leading to 181,514,680 ha of responsibly managed forest (FSC, 2014b) (see Figure 4).

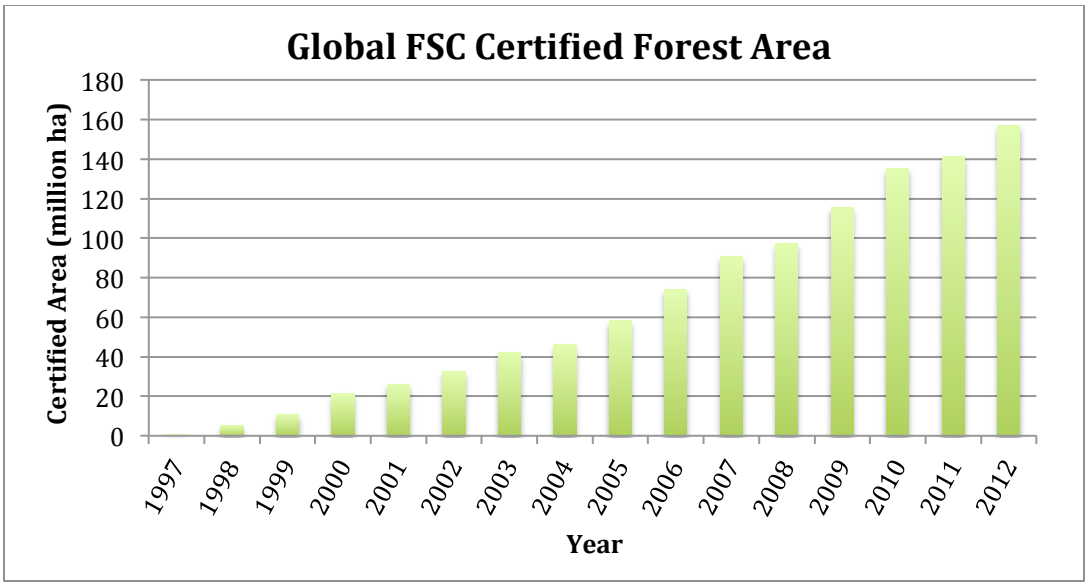

Figure 3. FSC certified area in million hectares per year, from 1997 to 2012. This graph demonstrates the increased participation in FSC certification over the years.

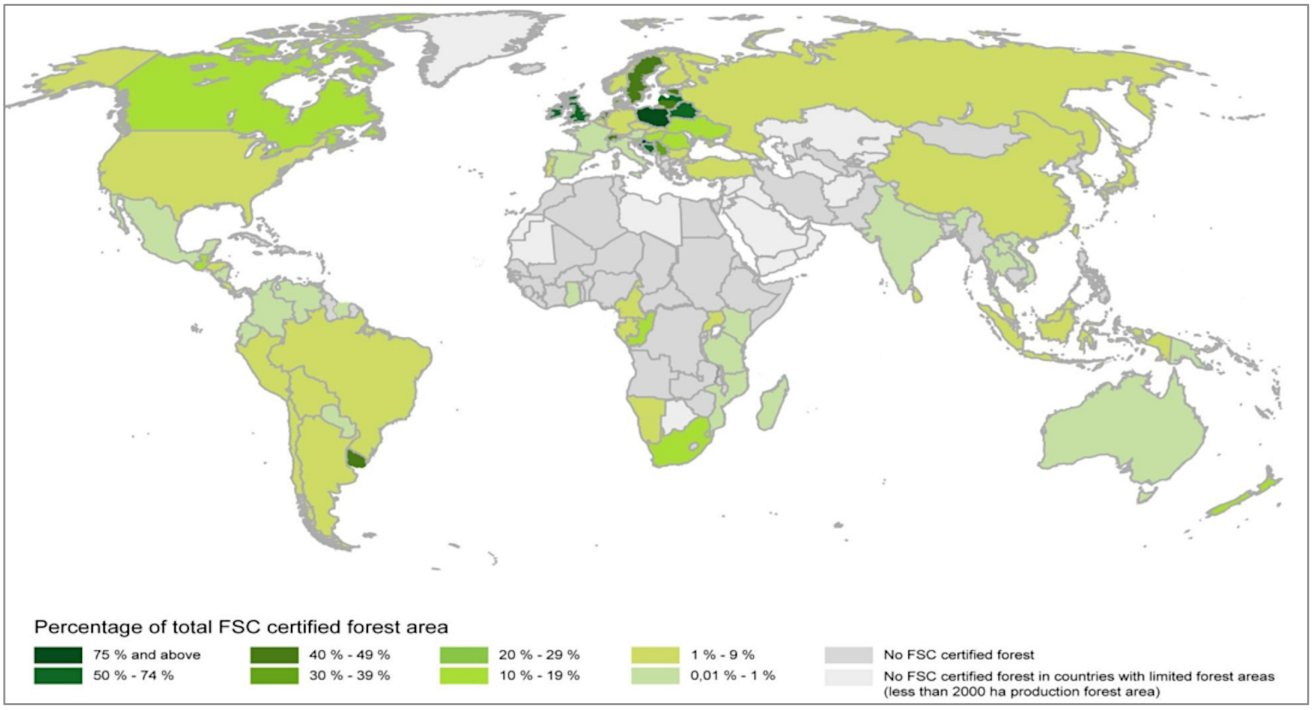

Figure 4. Global FSC certified forest area by country as of March 2014. Figure extracted from FSC (2014).

As a performance-based standard with a mission "to promote environmentally sound, socially beneficial and economically prosperous management of the world's forests," FSC requires forest management certificate holders to follow a set of specified principles and criteria (FSC, 2014a). These standards ensure: the conservation of environmental values and ecosystem services; compliance to all applicable laws and regulations; the

enhancement of workers' rights and conditions; water quality protection; the restriction of certain hazardous chemicals; the protection of forest ecology through reductions in clear-cutting; increased protection of high conservation value forests; the continued presence of natural forest cover through limits on deforestation; local and indigenous communities' participation and protection of their rights; transparent and democratic governance through open membership; proper monitoring and evaluation; and the continued economic viability of the land (FSC, 2014a).

Traditionally, maintaining an unexploited forest is not seen as a particularly profitable option for landowners. Instead, people are drawn to the economic benefit of deforestation, for development or agriculture, and forest degradation, for logging. While deforestation rates have slowed over the past decade, close to 13 million hectares of forest are still lost each year (FAO, 2010). Only about 20 percent of the world's original forests remain unexploited today (Basu and Nayak, 2011). Some of the most prominent driving forces of deforestation and forest degradation are conversion to agriculture and extraction, including both logging and fuel-wood collection (Pfaff et al., 2013).

Often the future value of forests is overlooked in favor of short-term economic returns. FSC, however, provides forest managers with a method of extracting profitable resources while also maintaining a viable forest. Through responsible forestry such as this, a forest's continued productivity and ecological diversity and processes remain intact while the sustainable harvest of timber takes place. This allows both landowners and the greater populations to enjoy the environmental and economic benefits the forest has to offer in the long-term (FSC, 2014a).

Forest certification schemes were originally created in response to deforestation, stemming particularly from concern for the deforestation of tropical forests (Teitelbaum and Wyatt, 2013; Chen and Innes, 2013) (see Figure 5). While there has been an increase in participation over the last decade, overall rates of certification for sustainable forest management still remain relatively low. Of the world's current forested area, less than 5% is certified by FSC. Substantial room exists for the expansion of forest certification programs such as this. Specifically, forest certification in tropical regions is severely

lacking. As of 2014, only 20 million hectares of tropical and subtropical forest is FSC certified compared to almost 95 million hectares of certified boreal forest (FSC, 2014b).

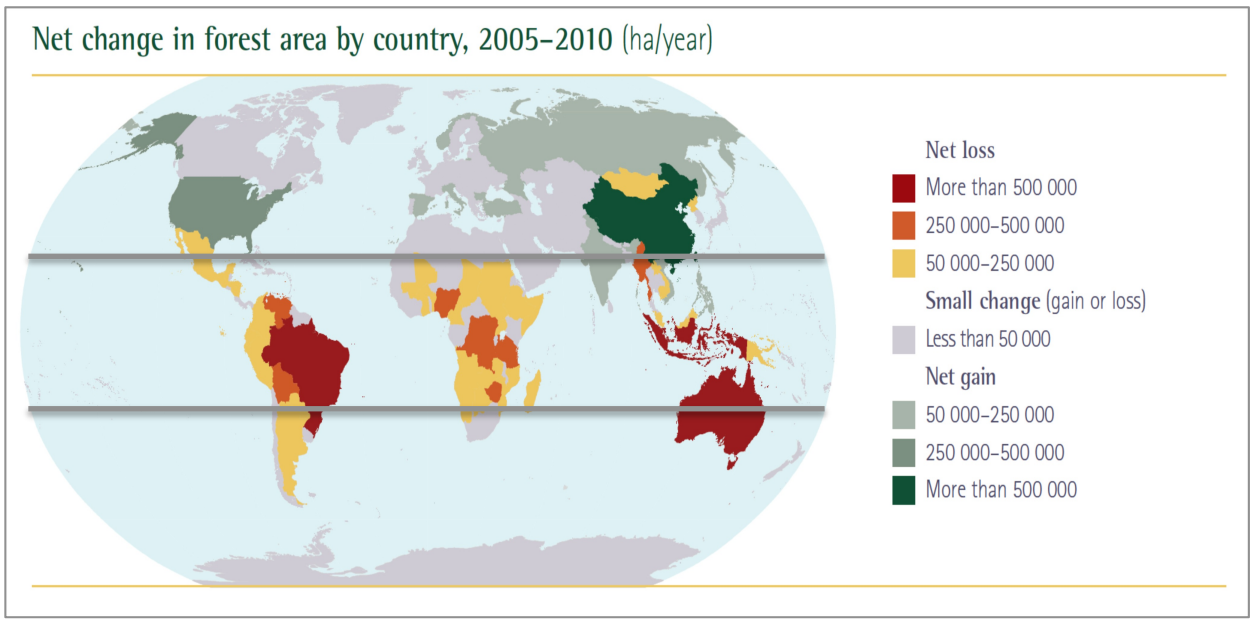

Figure 5. The net change in forest area by country from 2005 to 2010. The area between the horizontal grey lines signifies those countries located in the tropics. Figure retrieved from FAO (2010).

Much of the literature draws attention to the fact that forest certification has been most successful in developed countries with forests at low-risk of deforestation, while the primary target of these certification schemes have remained relatively unaffected (Durst et al., 2006; Leslie, 2004) (see Figures 6, 7, and 8). This has significant implications for forest conservation efforts. Tropical forests have considerably higher biodiversity than other biomes (Durst et al. 2006) and also act as the largest terrestrial store of carbon (Trumper et al., 2009). These two characteristics of tropical forests highlight the importance of further expanding forest certification in tropical regions. Thus, my project uses a multivariate regression approach to examine the underlying drivers of FSC and why its implementation has accelerated in some countries and not others.

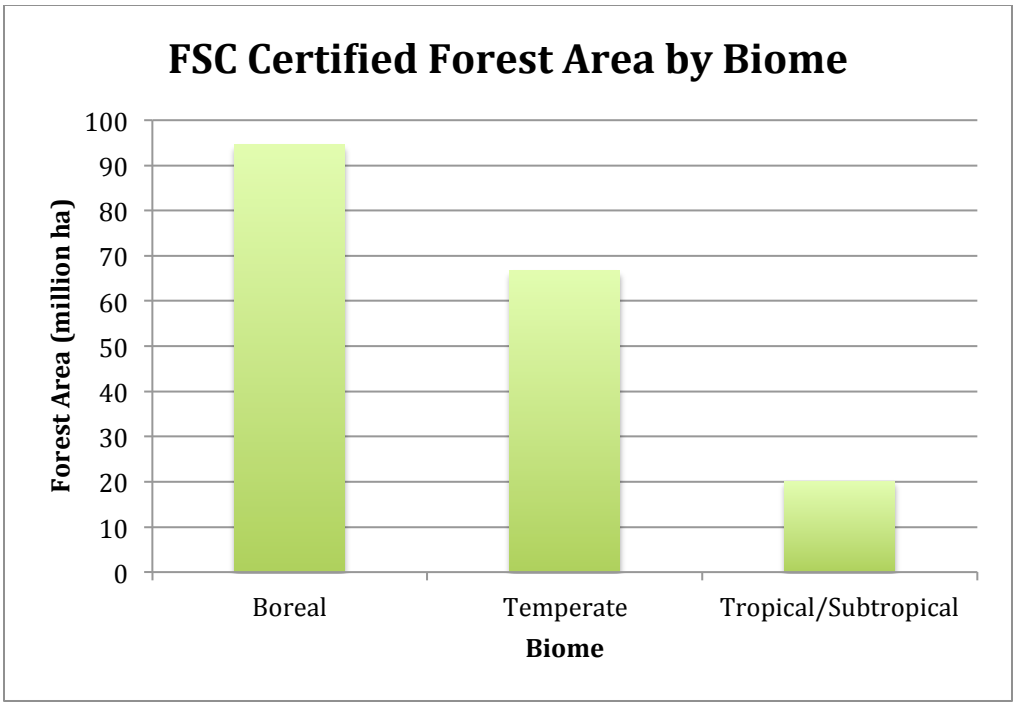

Figure 6. FSC certified forest area in million hectares by biome as of March 2014. This graph demonstrates the discrepancy between boreal and temperate forest certification and tropical/sub-tropical forest certification.

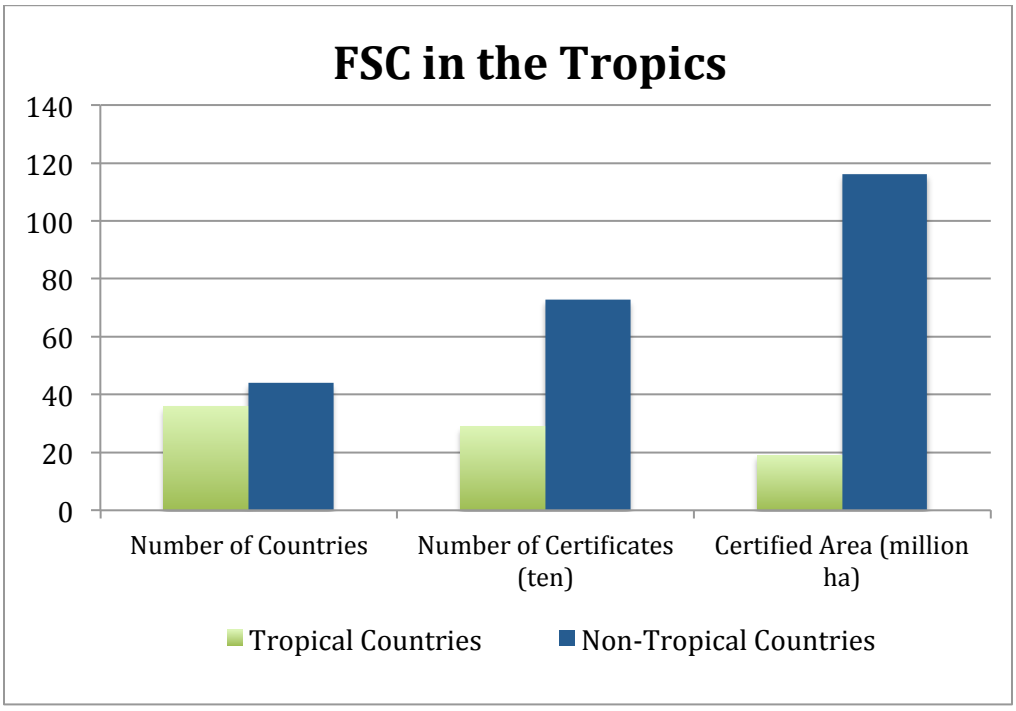

Figure 7. Comparison of FSC in the tropics to those countries not located in tropical regions.

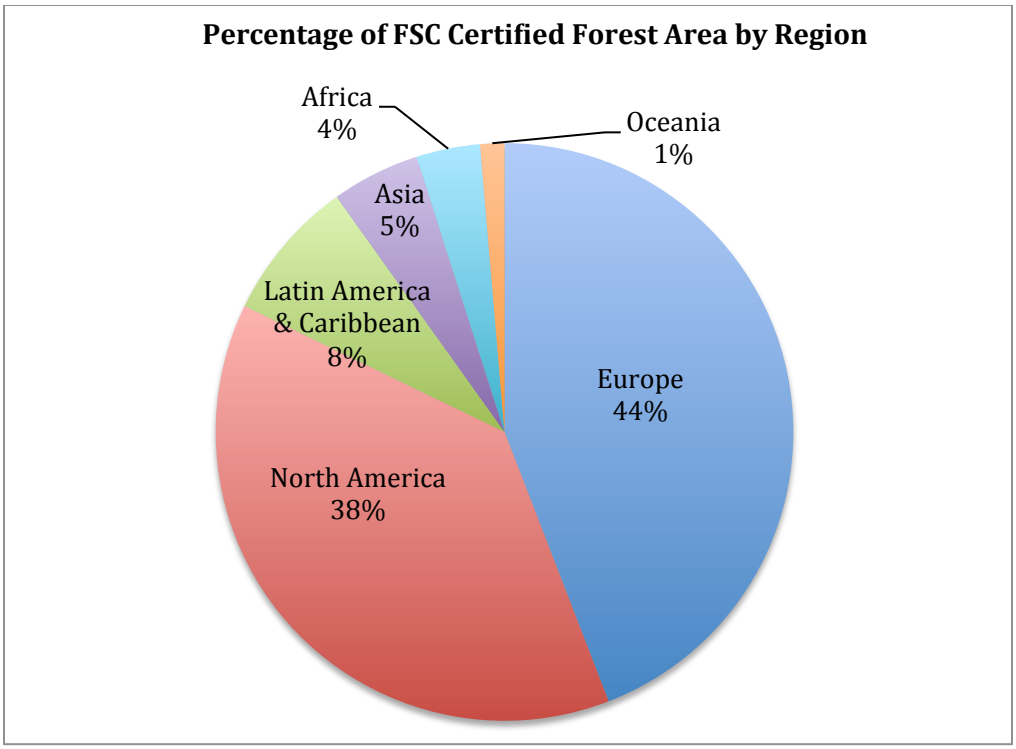

Figure 8. FSC certified forest area by region. Europe and North America largely dominate.

Methods

Modeling FSC forest certification

This study aims to improve our understanding of the factors that may be hindering the adoption and expansion of forest certification schemes. Specifically, I examine how in-country indicators might influence the presence of FSC certification in that country. Van Kooten et al. (2005) previously examined economic, institutional, and social capital national conditions to determine drivers of forest certification. They show that economic institutions and social context were important. Given that this study comes close to a decade later and FSC certified forest area has almost tripled since 2005, I hope to update and expand the findings in Van Kooten et al. (2005).

I draw on recent papers that use a similar multivariate cross-country regression approach to link country level environmental policies to socio-political and environmental factors. Recent examples of how country level indicators can explain environmental policies include studies of stove programs (Lewis et al., 2014) and of REDD+ projects (Lin

et al., 2012). The latter is directly relevant because the authors contend that the expansion of REDD+ projects across the tropical world could be explained by country level factors that proxy for expected benefits, expected costs, and risks. Following a similar logic, I hypothesize that the probability of FSC certified forests is linked to: governance performance; social pressure and environmental awareness; market influence; economic development; geographical location and habitat type; and forest regulation and ownership. This section discusses in greater detail some of the factors that might influence the presence of FSC certified forests within a country. All data included in the model refers to 2010 or best available. Please see Table 5 in the Appendix for sources of data.

Governance Performance

Forest certification by the FSC is a voluntary agreement, entered upon without state involvement. However, despite this dissociation, prior literature points to a more involved relationship between governments and the FSC, revealing both facilitation (Hysing, 2009) and mutual benefits (Bell and Hindmoor, 2012). While this type of forest certification may not directly depend on state involvement, many of the factors that influence its success largely stem from governmental activity. For example, a stable economy and ability to easily trade on the international market is necessary for forest managers to have confidence that a market for their timber will continue to exist in the future. In countries marred by political unrest and corruption, landowners will likely be inclined to focus on the short-term economic benefits of the land, rather than the long-term viability of the forest, as land tenure rights and the future of the economy as well as their own wellbeing may be unclear. Without a legal means of proving and enforcing ownership, forest users have little incentive to seek forest certification (Durst et al., 2006). I hypothesize that the presence of FSC certified forests is positively correlated with governance performance, which is represented in the model by a variable which ranks countries based on the World Bank's six Worldwide Governance Indicators: voice and accountability; political stability and absence of violence/terrorism; government effectiveness; regulatory quality; rule of law; and control of corruption.

Social Pressure and Environmental Awareness

As has been shown in previous research, social pressures act as a significant driver of why firms choose to engage in voluntary environmental agreements (Blackman, 2010) or seek forest certification (Van Kooten et al., 2005). Specifically, people are more likely to seek certification in a society where they feel strong community pressures to act in a socially- and environmentally- responsible manner.

In a review of relevant literature, Blackman (2010) found numerous studies linking community pressure to environmental performance. Among various measures used to identify this link is the participation in voluntary environmental agreements, with Blackman and Bannister (1998) and Aden, Hong, and Rock (1999) finding a positive correlation. Similarly, I hypothesize that participation in the UN-REDD Program will positively predict participation in FSC. The UN-REDD Program is an initiative from the United Nations focused on Reducing Emissions from Deforestation and forest Degradation (REDD). Launched in 2008, the initiative has reached over 49 countries (UN-REDD Program, 2014). The existence of one such conservation-related scheme will likely predict the existence of another. Parties looking to expand FSC or REDD to new areas, may be drawn to countries that have shown prior ability to successfully implement some of these programs as well as prior interest in conservation and other environmental goals. Participation in the UN-REDD Program is included to represent a country's openness to conservation efforts as well as an awareness of the importance of environmental protection to maintain ecosystem services and the resulting increased social pressure to manage resources sustainably.

The proportion of threatened plant and mammal species on the IUCN Red List within a country to the total land area of that country is also included as a measure of external social pressures to manage forests in a responsible manner. Additionally, the percent of total land area that is designated as protected area is included for similar reasons. The increased presence of threatened species and protected areas may influence citizens' perception of the importance of conservation, creating both increased social pressure to act responsibly as well as one's own preference towards responsible management.

Significant evidence exists linking non-market benefits, such as a responsibility for environmental stewardship and social enrichment, to drivers of forest certification among firms (Humphries et al., 2001; Owari et al., 2006; Moore et al., 2012). Therefore, I predict a positive correlation between the two variables described above and the presence of FSC certified forest.

The freedom of expression, association, and media can be extremely influential as well. The ability for a society to exert such pressures are likely to be stronger in a state where citizens feel comfortable expressing their opinions and have the proper media outlets through which to do so. Additionally, indictors of expression and media are particularly important in regard to the spread of information regarding sustainable forestry practices and the benefits that result. The presence of FSC facilitates environmental learning through the dissemination of knowledge (Pattberg, 2005). The ease with which information can be spread through communities and across societies as a whole can lead to greater awareness of environmental stewardship, in turn increasing the prevalence of responsibly managed land and certified forests. The governance performance variable described above incorporates these conditions of 'voice'.

Market Influence

Prior research has found little evidence of a significant price premium in the market place for wood products from certified forests (Kiekens, 2000; Baldwin, 2001; Swallow and Sedio, 2002; Van Kooten et al., 2005; Durst et al., 2006; Chen et al., 2010). In the absence of a price premium, forest owners must be seeking certification for other reasons than purely economic, particularly when considering the costs of certification. Van Kooten et al. (2005) found evidence pointing towards a fear of losing one's share in the market as a driving force for forest certification. Similarly, other studies have found the security of market access to be a motivating factor for certification as well (Bass et al., 2001; Owari et al., 2006; Moore et al., 2012). The greatest demand for these certified wood products is found in North American and European markets (Durst et al., 2006; Owari et al., 2006). To represent this, I have included the proportion of a country's total forest products exported to North America and Europe to its total industrial roundwood

production. I hypothesize a positive relationship between the probability of FSC certified forests and the proportion of forest products exported to North America and Europe, as they are characterized by high consumer demand for certified forest products.

Economic Development

Economic development is an important factor in predicting the likelihood of forest certification for many reasons. Mellor (1998) claims that economic development is first necessary before the sustainable use of natural resources can follow. Impoverished populations will place pressure on forest resources due to their dependence on firewood and other forest products. Murphree (1993) found poverty to be both a determinant and a result of forest degradation. This is very much in line with the Environmental Kuznets Curve (EKC) hypothesis. The EKC hypothesis is the idea that as economic growth becomes less dependent on environmental capital and wealth grows, so does the pressure to both conserve and improve the environment (Kuznets, 1955). Building on studies that highlight the link between a country's wealth and deforestation rates (Rudel, 2002; Meyer et al., 2003; Rudel et al., 2005), Ewers (2006) found increased income led to increases in forest cover. With decreased pressure on forest resources from reductions in poverty and increased economic development, forest certification may become more likely. In a literature review by Blackman (2010), strong correlations were found between per capita income and a firm's voluntary decision to reduce emissions, leading to improved environmental performance (Pargal and Wheeler, 1996; Hartman, Huq, and Wheeler, 1997). These results suggest that income may be a driving force for voluntary improved environmental performance. For the reasons described above, gross national income per capita (GNI) has been included in the model as a proxy for the level of economic development, and I predict a positive correlation between FSC certified forest and GNI.

Geographic Location and Habitat Type

The FSC has received much criticism that it has failed to reach developing countries in the tropics (Molnar, 2003; Rametsteiner and Simula, 2003; Taylor, 2005; Klooster, 2005; Bell and Hindmoor, 2012) and that those countries in the global south are under-

represented in FSC governance (Dingwerth, 2008). This may lead to greater obstacles in achieving FSC certification for forests located in tropical developing counties. These criticisms suggest that FSC is predominantly located in developed countries with temperate and boreal forests. These forests were likely already being managed sustainably and costs to entry are of less concern in these developed countries (Durst et al., 2006).

In an effort to account for both geographic location as well as habitat type, included in the model are six forested ecoregions. As defined by World Wildlife Fund, an ecoregion is a "large unit of land containing a geographically distinct assemblage of species, natural communities, and environmental conditions" (WWF, 2014). Those included in the model are: tropical and subtropical moist broadleaf forests; tropical and subtropical dry broadleaf forests; tropical and subtropical coniferous forests; temperate broadleaf and mixed forests; temperate coniferous forests; and Mediterranean forests, woodlands, and scrub. Boreal forests as an ecoregion have been omitted from the model, as they perfectly predict the presence of FSC forest certification within a country. It is important to note that these variables do no necessarily represent the type of forest that is FSC certified but rather represent a likelihood that the type of certified, or non-certified, forest within a country will be of that ecoregion (see Figure 9). The inclusion of these variables is to determine whether the presence of certain types of forested habitat influences the presence of FSC certification.

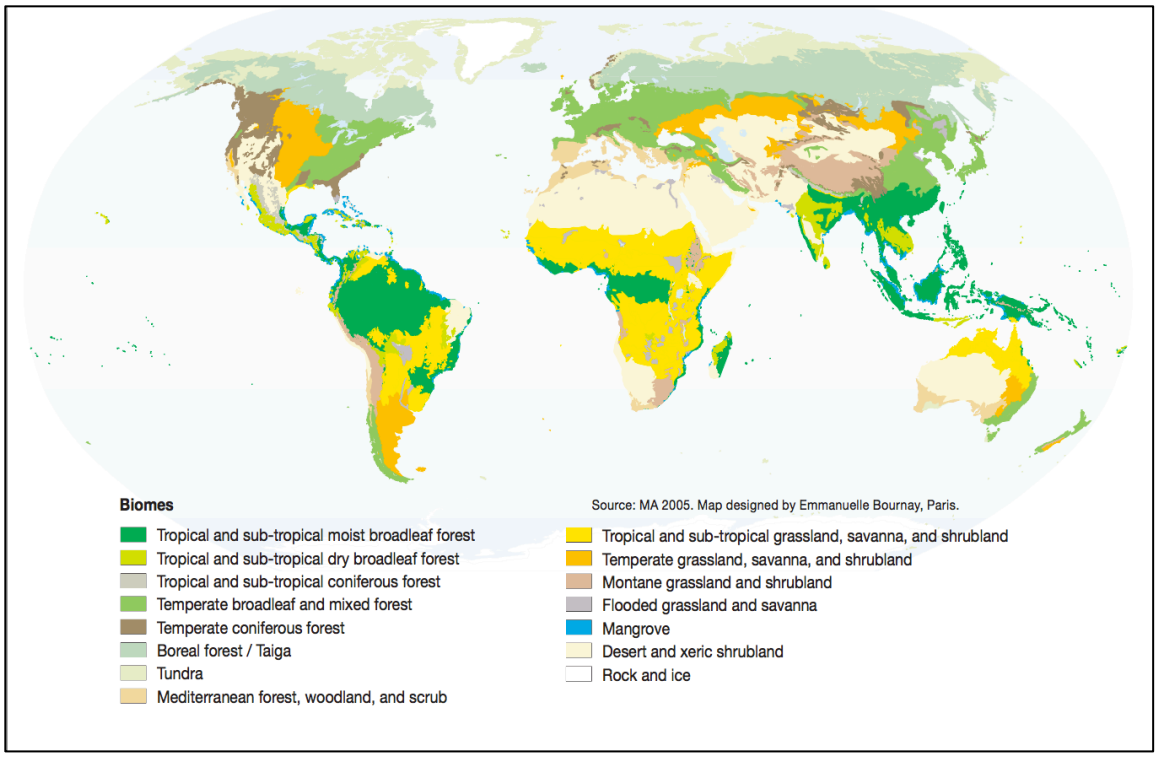

Figure 9. Biomes of the world. Figure retrieved from UNEP (2009).

Tropical forests contain the highest biodiversity and so their conservation may be of greater value. However, some critics have claimed that due to this greater biodiversity, these types of forests are more difficult to manage (Durst et al., 2006). Temperate forests, with much lower biodiversity on the other hand, can be easier to manage and in turn the ease of meeting certification standards is greater (Durst et al., 2006). I hypothesize the presence of FSC certified forest to be positively correlated with temperate habitats and inversely related to those that are tropical.

Forest Regulation and Ownership

It is important to recognize that forest certification decisions are made at the landowner level rather than the state level. Therefore, I have included the share of non-government owned forest over total forest area as a proxy for private interest. A country could have a high percentage of forest area with little actual area available for private management. I predict the presence of FSC certified forest to be positively correlated with non-government owned forest area.

Lastly, the model takes into account the existence of a national forest policy. Countries with existing forest regulations may already require that certain forest management standards be met. This may make it both easier and cheaper for forest owners to take the additional step to certification. Based on this, I hypothesize that the presence of FSC forest certification will be positively related to the existence of a national forest policy.

Multivariate regression analysis of factors influencing FSC presence

Logistic regression analysis was used to determine the different socio-economic, environmental, and institutional conditions that influence the presence of FSC certified forests within a country. The regression model is as follows:

$$\ln\left(\frac{y}{1-y}\right) = \beta_0 + \beta_1 x_{1j} + \cdots + \beta_n x_{nj} + \varepsilon_j$$

The dependent variable y_j is a binary variable signifying the presence of FSC certified forest within country j; β_k $(k = 1, \ldots, n)$ are the parameters that will be estimated as described in Table 1; and $\varepsilon_j \sim N(0, \sigma)$ are the normally distributed error terms. In addition to examining those conditions that influence the presence of FSC within a country, I examine if the same variables influence the amount of certified area within a country. This additional analysis was conducted as a robustness check. The regression model for this portion of my analysis is as follows:

$$Y_i = \beta_{0i} + \beta_{1i} x_{1j} + \cdots + \beta_{ni} x_{nj} + \varepsilon_{ij}$$
$$(i = \text{FSC certification})$$

The dependent variable Y_{ij} is a measure of the amount of certified forest area under FSC within country j (observations with zero certified area were increased to a have value of one); β_{ki} $(k = 1, \ldots, n)$ are the parameters that will be estimated as described in Table 1; and $\varepsilon_j \sim N(0, \sigma)$ are the normally distributed error terms.

Table 1. Summary of variables included in the regression models:

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum	Expected Sign
Dependent						
if FSC Certification =1	167	0.47	0.50	0	1	does not apply
FSC Certified Area	167	809255.90	3711405.00	0	35800000	does not apply
PEFC Certified Area	167	1545446.00	9863070.00	0	120000000	does not apply
Socio-Economic Regressors						
Gross National Income per capita (US$/100)	160	123.08	212.22	1.90	1869.50	+
Forest Exports to North America and Europe (% of total industrial roundwood production/1000)	167	797.14	2376.82	0	16244.98	+
Non-Government Owned Forest (% of total forest)	150	29.35	32.47	0	100	+
Policy/Institutional Regressors						
Governance Performance	160	1.91	0.64	1	3	+
Terrestrial Protected Areas (% of total land area)	161	16.24	12.21	0.15	61.29	+
UN-REDD Program Involvement	167	0.32	0.47	0	1	+
if National Forest Policy =1	147	0.79	0.41	0	1	+
Environmental Regressors						
Number of Threatened Species (per land area/100)	166	0.73	7.77	0	100	+
if Tropical and Subtropical Moist Broadleaf Forests =1	167	0.40	0.49	0	1	-
if Tropical and Subtropical Dry Broadleaf Forests =1	167	0.14	0.35	0	1	-
if Tropical and Subtropical Coniferous Forests =1	167	0.09	0.29	0	1	-
if Temperate Broadleaf and Mixed Forests =1	167	0.16	0.37	0	1	+
if Mediterranean Forests, Woodlands, Scrub =1	167	0.17	0.37	0	1	+
if Temperate Coniferous Forests =1	167	0.19	0.39	0	1	+

Results and Discussion

The sample size ranged from 138 countries to 160 countries depending on the model and the observations that were available for the included variables. Countries with less than 100,000 ha of forest were excluded. A summary of the explanatory variables included in the models is presented in Table 1. This table also shows the predicted effect the explanatory variable will have on the presence of FSC forest certification within a country.

The final logistic regression results for three different models are provided in Table 2. In all models, variables representing economic development and forest area ownership and regulation were not significant. Specifically, non-significant variables included gross national income per capita; the interaction term for the presence of a national forest

policy coupled with high governance performance; and the share of non-government owned forest. There was no significant effect of the number of threatened species per land area and the presence of four ecoregions (tropical and subtropical moist broadleaf forests; tropical and subtropical dry forests; temperate coniferous forests; and Mediterranean forests, woodlands, and scrub) in any of the models. The presence of tropical and subtropical coniferous forest and the percent of terrestrial protected areas were significant at the 0.05 or better level. The remainder of this paper discusses the variables that were statistically significant at 1% or higher (i.e., p-values of 0.01 or lower).

Governance Performance

Governance performance is positively correlated with the presence of FSC certified forest. As predicted, these results suggest the link between forest owners seeking certification and the ease with which this can be accomplished. There are increased incentives to certify when the proper conditions are in place, such as tenure security, economic stability, voice and accountability, and the quality of regulation and enforcement that contribute to a high level of governance performance.

Social Pressure and Environmental Awareness

In support of my original hypothesis, countries that have UN-REDD National Programs or are UN-REDD Program partner countries have a greater likelihood of having FSC certified forests. Involvement in UN-REDD activities likely signals a country's openness to conservation efforts as well as awareness of the role of forests in the provision of ecosystem services that benefit local communities. Participation in the UN-REDD program may educate communities on the importance of maintaining forest integrity, placing value on the practice of environmental stewardship. As the recognition of the benefits of sustainable forest management spreads, coupled with possible societal pressures, forest managers may be more likely to seek FSC certification.

Table 2. Presence of FSC certified forest: Logistic regression results

Explanatory Variable			
	1.596	2.064	3.464
Governance Performance	(2.99)**	(3.08)**	(3.19)**
	0.015	0.014	0.014
Forest Exports to North America and Europe (% of total production)	(4.05)**	(3.65)**	(2.94)**
	2.646	3.424	3.39
UN-REDD Program Participation	(4.73)**	(4.53)**	(3.12)**
		0.055	0.099
Terrestrial Protected Areas (% of total land area)		(2.14)*	(2.29)*
		3.635	5.33
if Temperate and Broadleaf Mixed Forests =1		(3.07)**	(3.06)**
		-2.136	-2.652
if Tropical and Subtropical Coniferous Forests =1		(2.38)*	(2.25)*
		1.753	2.586
if Tropical and Subtropical Dry Forests =1		(2.27)*	(2.42)*
			1.219
if Tropical and Subtropical Moist Forests =1			-1.22
			-0.111
if Mediterranean Forests, Woodlands, and Scrub =1			-0.06
			1.884
if Temperate Coniferous Forests =1			-1.06
			-0.009
Gross National Income (per capita)			-0.9
			-2.497
Number of Threatened Species (per land area)			-1.13
			0.006
Non-Government Owned Forest (% of total forest)			-0.51
			0.651
if National Forest Policy =1			-0.49
	-5.402	-7.957	-12.28
_cons	(4.52)**	(4.56)**	(3.81)**
Number of Observations	160	158	138

* Indicates statistical significance at 0.10.
** Indicates statistical significance at 0.05.

Market Influence

Countries that export a higher value of forest products to Europe and North America are more likely to have FSC certified forests. Forest operations in countries without a strong link to these markets, may face too high a barrier to entry to consider certification worth it. Previous studies have shown a lack of a price premium on FSC certified wood products and of those that have found a relationship, the price increase was minimal and unlikely to cover fees necessary for certification, particularly for small-scale operations (Swallow and Sedio, 2002; Taylor, 2005; Van Kooten et al., 2005).

This may also signify the influence of consumer demand. Despite a lack in willingness to pay for certified wood products, previous literature has shown that consumer demand for certified wood products does exist and is growing (Peck, 2002; Taylor, 2005). As consumer preference for certified forest products grows, forest managers may be more likely to obtain FSC certification to ensure their continued position in the market and trade with these countries. Consumers in Canada, the United States, and many European countries have expressed strong environmental values, placing pressure on large companies to partake in corporate responsibility measures (Peck, 2002; Durst et al., 2006). Consumers influence retailers who in turn determine what products they source and from where. Additionally, FSC specifically focuses on large-scale buyers as a method of spreading their certification (Taylor, 2005). Large retailers can have a very strong influence depending on their market share. For example, Home Depot and IKEA played an important role in the spread of FSC certification among forest managers in Mexico (Klooster, 2005). This might support the idea that smaller forest management operations are not seeking certification as often. These smaller-scale operations are not able to supply large retailers who are requesting FSC certified products in response to consumer demand and FSC promotion, and so they remain outside of the sphere of influence (Taylor, 2005). While the FSC is working to improve the inclusion of small-scale operations and those located in the global south, based on these results, further efforts must be considered.

Geographic Location and Habitat Type

Countries with temperate broadleaf and mixed forests are more likely to have FSC certified forests. Much of this type of habitat is located in China, North America, Russia, the Caucasus, Europe, and the Himalayas and is characterized by species such as oak, beech, birch, and maple mixed with evergreens (Olson and Dinerstein, 2002). Temperate forests are generally less diverse than for example tropical forests (Newton and Featherstone, 2005). Due to this lower diversity, the standards required to meet certification may be easier to achieve (Durst et al., 2006). Such incentives may lead forest managers to seek certification or make it easier for them to receive certification for the land they are sustainably managing. This is one likely explanation as to why we see a positive relationship between this biome and the probability of FSC certified forests.

Additionally, much of this type of forest is located in countries with high economic development where land values are likely to be high, especially when coupled with agricultural value (Newton and Featherstone, 2005). Therefore, it is possible that economic development is accompanied by a greater sense of environmental stewardship by forest managers in these regions: they seek certification because they recognize the long-term benefits of the forest.

Factors influencing amount of FSC

The parameters included in the preferred model, as determined above, were also used in ordinary least squares regression to determine their influence on the amount of certified forest area within a country. The detailed results can be found in Table 3. All variables that were significant in the previous model remained statistically significant at 5% or higher (i.e., p-values of 0.05 or lower).

Table 3. FSC certified forest area: Ordinary Least Squares regression results

Explanatory Variable			
Governance Performance	3.839	2.97	2.842
	(5.16)**	(4.16)**	(2.95)**
Forest Exports to North America and Europe (% of total production)	0.001	0.001	0
	(3.59)**	(3.45)**	(2.23)*
UN-REDD Program Participation	3.177	4.166	3.72
	(3.46)**	(4.58)**	(3.32)**
Terrestrial Protected Areas (% of total land area)		0.088	0.104
		(2.49)*	(2.65)**
if Temperate and Broadleaf Mixed Forests =1		6.04	6.54
		(5.47)**	(5.33)**
if Tropical and Subtropical Coniferous Forests =1		-4.403	-4.446
		(2.95)**	(2.51)*
if Tropical and Subtropical Dry Forests =1		2.441	3.223
		(2.04)*	(2.48)*
if Tropical and Subtropical Moist Forests =1			0.845
			-0.76
if Mediterranean Forests, Woodlands, and Scrub =1			0.951
			-0.75
if Temperate Coniferous Forests =1			1.642
			-1.32
Gross National Income (per capita)			-0.001
			-0.19
Number of Threatened Species (per land area)			-3.141
			(2.03)*
Non-Government Owned Forest (% of total forest)			0.015
			-1.06
if National Forest Policy =1			0.622
			-0.58
_cons	-2.968	-3.845	-5.026
	(1.99)*	(2.80)**	(2.79)**
R^2	0.31	0.45	0.5
Number of Observations	160	158	138

* Indicates statistical significance at 0.10.

** Indicates statistical significance at 0.05.

One concern could be that other forms of certification – e.g., PEFC - are substituting for FSC certification. In Table 4 of the Appendix, I report detailed results for application of the same model as in Table 3, but using the amount of PEFC certified forest area as the dependent variable. Results indicate that only governance performance, forest exports to North America and Europe, and gross national income remain statistically significant at 1% or higher (i.e., p-values of 0.01 or lower).

Conclusions

Through an improved understanding of the context under which forest certification is sought, I have identified in-country factors correlated with the adoption of this certification. My results support findings of previous literature (e.g., Van Kooten et al., 2005) that the socio-economic and institutional context within a country is of particular importance in terms of its influence on forest certification decisions at the landowner level. I add to this literature by showing that the existence of conservation initiatives and environmental awareness are significantly correlated with FSC. Explanatory factors include increased social pressure to act in an environmentally responsible manner as well as a sense of environmental stewardship among forest owners and managers in locations with conservation initiatives and environmental awareness.

The amount of forest exports to North America and Europe had a positive relationship with the likelihood that firms or forest landowners would seek FSC certification. In the absence of a price premium, this may point to a firm's desire to retain its market share due to the high demand for certified wood products from these regions. This signifies the importance of opening forestry trade channels between Europe and North America and those countries in which FSC has yet to establish a presence.

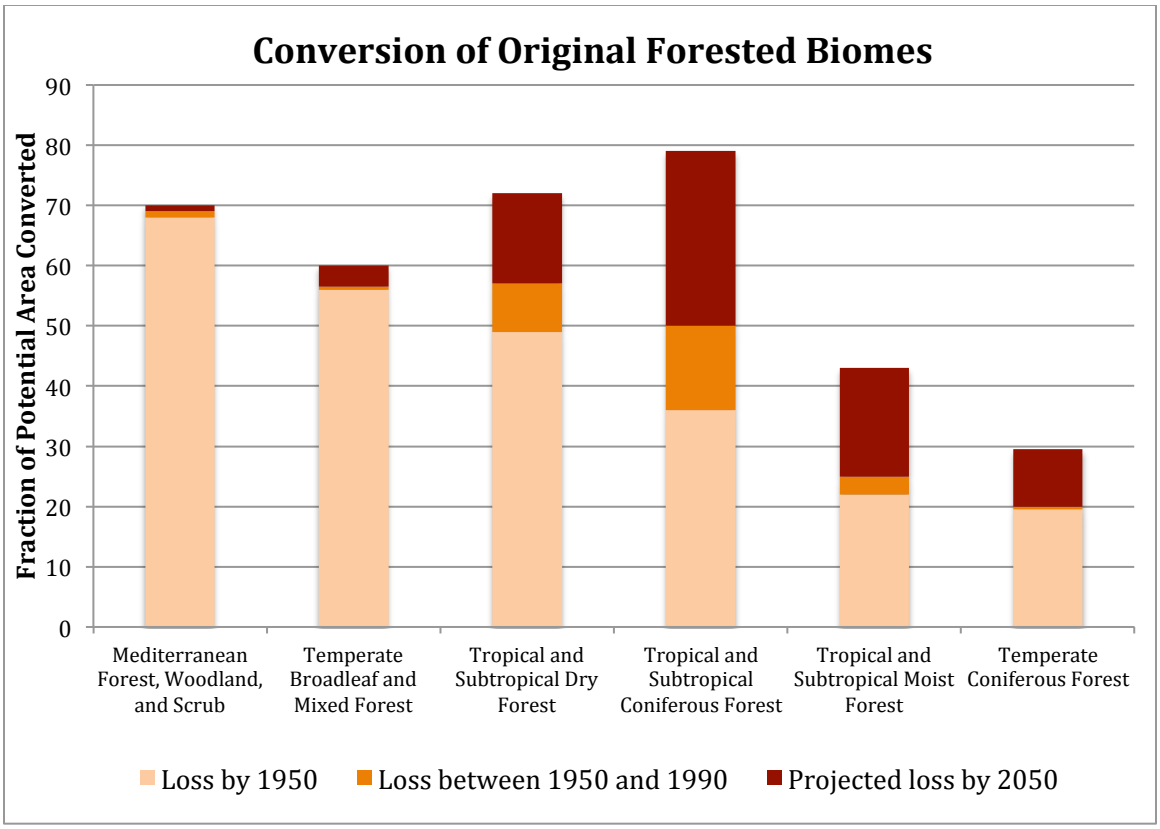

Figure 10. The conversion of original forested biomes. Future projections are based on four scenarios as estimated in the Millennium Ecosystem Assessment 2005. This figure is based on a similar figure extracted from UNEP (2009) and reconstructed for clarity.

Lastly, the significance of habitat type on the likelihood of FSC certification has implications for the scope of FSC. From a historical perspective, temperate broadleaf and mixed forests underwent significant land conversion prior to the 1950s. This may likely be one of the driving factors for the increased responsible management of forests in countries with this biome present. However, in terms of future projected losses according to the 2005 Millennium Ecosystem Assessment, this biome is not of particular concern (see Figure 10). On the other hand, tropical and sub-tropical coniferous forests are likely to experience significant losses over the next 35 years. Results of this study found a significant negative relationship between tropical and sub-tropical coniferous forests and the likelihood of FSC forest certification. It is encouraging that forest managers in countries with this type of biome are participating in FSC certification. If FSC certified forests are already present in a country then it is likely that certification throughout that country, and across this biome, can spread with greater ease. Landowners are more likely to be familiar with FSC and the social and institutional context of the country likely

satisfies the needs of certification. Tropical and subtropical dry forests, tropical and subtropical moist forests, and temperate coniferous forests are also projected to undergo significant forest loss by 2050. FSC should target landowners of these forests types.

Implications and Future Research

This study contributes to understanding of the context in which firms and landowners seek forest certification. Due to the continued high rates of deforestation and forest degradation, as well as increased pressures on habitats and forest-dependent people from climate change and population growth, we face a critical need for implementing and evaluating new and creative conservation mechanisms (Ferraro & Pattanayak, 2006; Pattanayak et al., 2010). This study identifies in-country factors correlated with the implementation of forest certification. FSC can be expanded by addressing factors that may inhibit adoption practices, such as the lack of awareness of forest certification, barriers to market entry, and the ease of certification. If FSC is to become an effective conservation tool, ultimately, FSC implementation must be accompanied by rigorous, empirical research on whether FSC reduces deforestation and improves local livelihoods (Miteva et al., 2014).

Acknowledgements

This paper has benefited greatly from the guidance and encouragement of many people along the way. I would like to thank Marion Karmann from the FSC International Center, Germany, for responding to my inquiries and providing some of the data essential to the complexity of this analysis. Thank you to Jeffrey Vincent for his experienced insight and valuable suggestions on the formulation of the model. I would like to thank my advisor, Subhrendu K. Pattanayak, for his support to pursue my interests in the initial stages of this project as well as his assistance and advice throughout. Lastly, I would like to thank family and friends for their continued encouragement and eagerness to review my work with fresh eyes.

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Appendix

Table 4. PEFC certified forest area: Ordinary Least Squares regression results

Explanatory Variable			
Governance Performance	2.167	1.854	0.544
	(4.09)**	(3.36)**	-0.69
Forest Exports to North America and Europe (% of total production)	0.001	0.001	0.001
	(9.11)**	(8.94)**	(5.60)**
UN-REDD Program Participation	-1.278	-0.707	-0.319
	-1.95	-1	-0.35
Terrestrial Protected Areas (% of total land area)		0.043	0.047
		-1.56	-1.47
if Temperate and Broadleaf Mixed Forests =1		2.141	1.715
		(2.51)*	-1.72
if Tropical and Subtropical Coniferous Forests =1		-1.329	-1.012
		-1.15	-0.7
if Tropical and Subtropical Dry Forests =1		-0.457	-0.144
		-0.49	-0.14
if Tropical and Subtropical Moist Forests =1			0.311
			-0.35
if Mediterranean Forests, Woodlands, and Scrub =1			0.56
			-0.54
if Temperate Coniferous Forests =1			1.45
			-1.43
Gross National Income (per capita)			0.009
			(2.72)**
Number of Threatened Species (per land area)			-1.392
			-1.11
Non-Government Owned Forest (% of total forest)			0.015
			-1.27
if National Forest Policy =1			-0.197
			-0.23
_cons	-2.323	-2.697	-1.642
	(2.19)*	(2.54)*	-1.12
R^2	0.55	0.58	0.62
Number of Observations	160	158	138

* Indicates statistical significance at 0.10.

** Indicates statistical significance at 0.05.

Table 5. Sources of the data used to formulate variables included in the regression analysis.

Variable	Source
Dependent	
if FSC Certification =1	FSC. (2014). Global FSC certificates: type and distribution March 2014. Forest Stewardship Council International, Bonn, Germany.
FSC Certified Area	FSC. (2014). Global FSC certificates: type and distribution March 2014. Forest Stewardship Council International, Bonn, Germany. Annual FSC certified area data provided by Marion Karmann from the FSC International Center, Germany (personal communication, January, 2014).
PEFC Certified Area	PEFC. (2014). PEFC global statistics: SFM & CoC certification. PEFC International, Geneva, Switzerland.
Socio-Economic Regressors	
Gross National Income per capita (US$/100)	The World Bank. Data. Retrieved March 2014, from http://data.worldbank.org/indicator/all.
Forest Exports to North America and Europe (% of total industrial roundwood production/1000)	FAOSTAT. ForesSTAT and Forestry Trade Flows. FAO Statistics Division. Retrieved March 2014, from http://faostat.fao.org/site/628/default.aspx.
Non-Government Owned Forest (% of total forest)	FAO. Global Forest Resources Assessment 2010. Retrieved March 2014, from http://www.fao.org/forestry/fra/fra2010/en/
Policy/Institutional Regressors	
Governance Performance	The World Bank Group. The Worldwide Governance Indicators, 2013. Retrieved March 2014, from http://www.govindicators.org
Terrestrial Protected Areas (% of total land area)	The World Bank. Data. Retrieved March 2014, from http://data.worldbank.org/indicator/all.
UN-REDD Program Involvement	UN-REDD Programme. UN-REDD Program Regions and Partner Countries. Retreived March 2014, from http://www.un-redd.org/Partner_Countries/tabid/102663/Default.aspx
National Forest Policy	FAO. (2010). Global Forest Resources Assessment 2010. United Nations Food and Agriculture Organization, Rome, Italy.
Environmental Regressors	
Number of Threatened Species (per land area/100)	The World Bank. Data. Retrieved March 2014, from http://data.worldbank.org/indicator/all.
if Tropical and Subtropical Moist Broadleaf Forests =1	Olson, D. M., Dinerstein, E. 2002. The Global 200: Priority ecoregions for global conservation. Annals of the Missouri Botanical Garden 89(2):199-224.

if Tropical and Subtropical Dry Broadleaf Forests =1	Olson, D. M., Dinerstein, E. 2002. The Global 200: Priority ecoregions for global conservation. Annals of the Missouri Botanical Garden 89(2):199-224.
if Tropical and Subtropical Coniferous Forests =1	Olson, D. M., Dinerstein, E. 2002. The Global 200: Priority ecoregions for global conservation. Annals of the Missouri Botanical Garden 89(2):199-224.
if Temperate Broadleaf and Mixed Forests =1	Olson, D. M., Dinerstein, E. 2002. The Global 200: Priority ecoregions for global conservation. Annals of the Missouri Botanical Garden 89(2):199-224.
if Mediterranean Forests, Woodlands, Scrub =1	Olson, D. M., Dinerstein, E. 2002. The Global 200: Priority ecoregions for global conservation. Annals of the Missouri Botanical Garden 89(2):199-224.
if Temperate Coniferous Forests =1	Olson, D. M., Dinerstein, E. 2002. The Global 200: Priority ecoregions for global conservation. Annals of the Missouri Botanical Garden 89(2):199-224.